Traffic Information Collection and Integration
Developments and Directions

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Workshop Description

Effective navigation is dependent on accurate and timely traffic congestion and traffic flow information. Loop sensors and cameras provide dependable data on the roadways where they are installed, but they are expensive to put in place and to maintain. This workshop will look at the potential for expanding real-time traffic data collection systems to cover more roadways and provide more up-to-date information for navigation systems.

The causes of traffic congestion have been catalogued by government agencies around the world in countless reports and documents. They all say about the same thing, that approximately one-half of the causes are predictable (recurring and non-recurring events and poor signal timing), and the other half are inevitable (incidents, weather, work zones). Current traffic collection methods have focused on the inevitable. New systems, such as mobile phone tracking, will focus on integrating predictive traffic data into the mix of information provided in navigation system databases. This workshop will explore these new systems and their possible impact.

Improved data collection methods will require improvements in the way traffic information is delivered. The current RDS-TMC message broadcasting has proved surprisingly robust. However, message size and pre-coding of locations have always been troublesome, and are proving to be obstacles to expanding both quantity and quality of data delivery. New methods are emerging for referencing the locations of incidents and for coding traffic and other information methods. There are also new technologies becoming available for delivering these messages to vehicles. This workshop will explore all of these new possibilities.
The Workshop

- What causes traffic congestion?
- What does traffic measuring try to accomplish?
- Who is playing in the traffic congestion monitoring field?
- Is there an innovation waiting to be monetized?
- This workshop will look at the potential for expanding real-time traffic data collection systems to cover more roadways and provide more up-to-date information for navigation systems.
Traffic congestion is not new, but it has gone from being an exceptional event to an everyday affair.

### Means of Transportation to Work: 1990 and 2000

<table>
<thead>
<tr>
<th>Means of Transportation</th>
<th>1990 %</th>
<th>2000 %</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car, truck or van</td>
<td>86.5</td>
<td>87.9</td>
<td>1.3</td>
</tr>
<tr>
<td>Drove alone</td>
<td>73.2</td>
<td>75.7</td>
<td>2.5</td>
</tr>
<tr>
<td>Carpoled</td>
<td>13.4</td>
<td>12.2</td>
<td>-1.2</td>
</tr>
<tr>
<td>Bus</td>
<td>3.0</td>
<td>2.5</td>
<td>-0.5</td>
</tr>
<tr>
<td>Streetcar or trolley</td>
<td>0.1</td>
<td>0.1</td>
<td>-</td>
</tr>
<tr>
<td>Subway or elevated</td>
<td>1.5</td>
<td>1.5</td>
<td>-</td>
</tr>
<tr>
<td>Railroad</td>
<td>0.5</td>
<td>0.5</td>
<td>-</td>
</tr>
<tr>
<td>Ferryboat</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Taxicab</td>
<td>0.2</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Motorcycle</td>
<td>0.2</td>
<td>0.1</td>
<td>-0.1</td>
</tr>
<tr>
<td>Bicycle</td>
<td>0.4</td>
<td>0.4</td>
<td>-</td>
</tr>
<tr>
<td>Walked</td>
<td>3.9</td>
<td>2.9</td>
<td>-1.0</td>
</tr>
<tr>
<td>Other means</td>
<td>0.7</td>
<td>0.7</td>
<td>-</td>
</tr>
<tr>
<td>Worked at home</td>
<td>3.0</td>
<td>3.3</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Source: U.S. Census Bureau, 1990 Census Summary Tape File 3 and Census 2000 Summary File 3
The first GPS satellite was put into orbit in February 1978. The first civilian use of the system came in 1984, but full-fledged use began in July 1995 when the full complement of twenty-four primary and one reserve were in orbit.
Premises

- Effective navigation is dependent on accurate and timely traffic congestion and traffic flow information.
- Loop sensors and cameras provide dependable data on the roadways where they are installed, but they are expensive to put in place and to maintain.
- The causes of traffic congestion have been catalogued by government agencies around the world in countless reports and documents. They all say about the same thing.
- Approximately one-half of the causes are predictable (recurring and non-recurring events and poor signal timing), and the other half are inevitable (incidents, weather, work zones).
Premises

- Current traffic collection methods have focused on the *inevitable*.
- New systems, such as mobile phone tracking, will focus on integrating **predictive** traffic data into the mix of information provided in navigation system databases.
- **RDS-TMC** message broadcasting has proved surprisingly robust. However, message size and pre-coding of locations have always been troublesome, and are proving to be obstacles to expanding both quantity and quality of data delivery.
- Improved data collection methods will require improvements in the way traffic information is delivered.
- New methods are emerging for referencing the locations of incidents and for coding traffic and other information methods.

*Same place; different time.*

*It’s like this every weeknight in Moscow*
The Roots of Traffic Congestion

- The number of cars in the world doubled to 200 million from 1950 to 1970, and doubled again in the next twenty years.
- Sales are expected to level off in Europe, but sales in China (25% increase 2005-2006), India (18%) and Southeast Asia are expected to grow.
- China is building new roads at a breakneck pace (40,000 km added between 1995 and 2007)--just like the US did in the 1950s and '60s, and Europe did in the 1960s and '70s.
The Roots of Traffic Congestion

- There are too many of these great inventions driving longer distances on proportionately fewer kilometres of roads.
- The real question is Why has this explosive growth in car ownership and driving occurred?
- Population growth is not the only explanation; mostly just poor planning

...by the way, I realise this is all good news for the industries selling cars and trucks
The Roots of Traffic Congestion

- The Predictable events comprise 60% of the reasons for traffic congestion
  - Work Zones
  - Poor Signal Timing
  - Other recurring
  - Other non-recurring
- The Inevitable events comprise the remaining 40%
  - Weather
  - Incidents

Traffic Information Provision

Main Aspects of Traffic Information Provision

- Traffic information delivery today in Europe is almost exclusively based on the RDS-TMC method, both for audio delivery over radio networks and for data delivery to special-purpose traffic information systems and integrated navigation systems.

- **TMC Services are expanding into other countries**, and are now also in place in America; they will launch during 2007 in Australia; they have been demonstrated in China; and, they are under development for a number of other countries.

- **TPEG will replace RDS-TMC** within the coming five years as digital radio systems (T-DAB, SDRS, HD-Radio) replace FM radios in vehicles.

- Traveller Information Services Organisation (TISA) first meeting in Berlin (Nov 21).

**Transport Protocol Expert Group**

- TPEG Forum

  The TPEG Forum manages the standardisation activities for TPEG.

  Developments occurring in other parts of the world outside of Europe (e.g., Korea) are incorporated into the standardisation activities through the TPEG Forum.

- Status of standardisation

  - TPEG Binary and TPEG XML are now official CEN/ISO standards

**Direction**

- TMC Forum and TPEG Forum jointly formed the Road Transport Information Group and are now joining forces in TISA.
Traffic Information in Europe

RDS-TMC Service in Europe 2006
- Free Service
- Subscription Service
- Planned Service
- Not Available

Traffic Data Suppliers
- Standard RDS-TMC FM Broadcast TMC/ALERT-C Coded
  5 bytes/message—60 messages per minute on a 1200 bits per second network.
- Pays for RDS-TMC Data Feeds
- Broadcast Fee

Country or Regional FM Radio Company
- Pays for RDS-TMC Data Feeds
- FM Broadcast with RDS-TMC

FM Antenna and Tuner for RDS-TMC
- Pays for RDS-TMC Data Feeds
- Delivers Data to Navigation System

Navigation System
- Delivers System to Vehicle OEM
- Delivers Technology Assistance to Customer

Vehicle OEM
- Pays for Vehicle with Navigation and RDS-TMC Reception

Customer
Most of the users of traffic information in Europe today receive the information via an integrated route guidance system that is equipped with an integrated FM antenna and are delivered with the location tables for the free service areas and selected location tables with the appropriate decryption software for the fee-based services.
Traffic Information Data Delivery

- The costs for the *fee-based systems* are pre-paid by either the navigation system supplier or the OEM into whose vehicles the systems are installed.
- By my estimates, there are approximately 3 million users of RDS-TMC traffic information receivers in vehicles in 2006. Added to this, there are an estimated 200,000 – 300,000 users of special-purpose traffic information devices from companies like Trafficmaster and Mediamobile.
Radio Data System-Traffic Message Channel

- A brilliantly simple technique for coding traffic messages in any language under the sun.
- It was originally designed as a way of transferring traffic information from traffic control centres to broadcasters.
Radio Data System-Traffic Message Channel

Positive Direction

Offset=2 in Negative Direction

Event Location (15, not 169)
## ALERT-C Location Code Table

<table>
<thead>
<tr>
<th>Location Code</th>
<th>Type</th>
<th>Road Number</th>
<th>First Name</th>
<th>Second Name</th>
<th>Ref A</th>
<th>Ref L</th>
<th>- offset</th>
<th>+ offset</th>
<th>Long/Lat</th>
</tr>
</thead>
<tbody>
<tr>
<td>1100</td>
<td>P1.11</td>
<td>Rt A</td>
<td>Village X</td>
<td>Main St</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td>1101</td>
</tr>
<tr>
<td>1101</td>
<td>P3.34</td>
<td>Rt A</td>
<td>Town Hall H</td>
<td>Main St</td>
<td>10</td>
<td></td>
<td></td>
<td>1100</td>
<td>1102</td>
</tr>
<tr>
<td>1102</td>
<td>P1.1</td>
<td>Rt A</td>
<td>Junction J</td>
<td>Main St</td>
<td>2001</td>
<td></td>
<td></td>
<td>1101</td>
<td>1103</td>
</tr>
<tr>
<td>1103</td>
<td>P1.1</td>
<td>Rt A</td>
<td>Village Z</td>
<td>Main St</td>
<td>2001</td>
<td></td>
<td></td>
<td>1102</td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>P3.1</td>
<td>Rt B</td>
<td>Tunnel P</td>
<td></td>
<td>1110</td>
<td>756</td>
<td></td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>P1.1</td>
<td>Rt B</td>
<td>Junction J</td>
<td>Rt A</td>
<td>2001</td>
<td></td>
<td>55</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>57</td>
<td>P3.2</td>
<td>Rt B</td>
<td>Bridge K</td>
<td></td>
<td>2001</td>
<td></td>
<td></td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>756</td>
<td>L1.1</td>
<td>Rt C</td>
<td>S-Town</td>
<td>t-Town</td>
<td>1110</td>
<td></td>
<td></td>
<td>757</td>
<td></td>
</tr>
<tr>
<td>757</td>
<td>L1.1</td>
<td>Rt C</td>
<td>S-Town</td>
<td>u-Town</td>
<td>2001</td>
<td>756</td>
<td></td>
<td>758</td>
<td></td>
</tr>
<tr>
<td>758</td>
<td>L1.1</td>
<td>Rt C</td>
<td>S-Town</td>
<td>v-Town</td>
<td>2001</td>
<td></td>
<td></td>
<td>757</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>A.</td>
<td></td>
<td>Village X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2001</td>
<td></td>
</tr>
<tr>
<td>1110</td>
<td>A.</td>
<td></td>
<td>Tunnel P</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2001</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>A.</td>
<td></td>
<td>State S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>A.</td>
<td></td>
<td>City Y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2000</td>
<td></td>
</tr>
</tbody>
</table>
RDS-TMC Traffic Message

- An event is recorded using one of several thousand different event codes, each one describing a particular type of event, such as Code 103 meaning **Stationary traffic for 2 km.**
- Every location in a country’s database is unique within a Location Code Table.
- Direction is related to the coding of the database, not compass or direction of traffic.
- Duration is a subjective estimate made by the traffic controller.

<table>
<thead>
<tr>
<th>Event Code</th>
<th>Language 1</th>
<th>Language 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>103</td>
<td>Stationary traffic for 2 km.</td>
<td>Stillastående trafik i 2 km</td>
</tr>
</tbody>
</table>
Navigable Database Coding

Navteq Coding

PLOC 13
-0013
+0014

PLOC 14
N0014
P0014

PLOC 15
N0014
P0014

Positive Road Direction

13
14
15
# RDS-TMC Services in Europe

<table>
<thead>
<tr>
<th>Country</th>
<th>Public Provider</th>
<th>Free</th>
<th>Commercial Provider</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Road Administration</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belgium</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flanders (North)</td>
<td>Flanders Road Admin</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walloon (South)</td>
<td>TMC4U</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Czech Republic</td>
<td>Planned - Road Admin</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>Road Administration</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finland</td>
<td>Road Administration</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>Motorway Operators</td>
<td>✓</td>
<td>Mediamobile</td>
<td>✓</td>
</tr>
<tr>
<td>Germany</td>
<td>Public Radio Stations</td>
<td>✓</td>
<td>T-Mobile Traffic</td>
<td>✓</td>
</tr>
<tr>
<td>Hungary</td>
<td>Planned - Road Admin</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Republic of Ireland</td>
<td>Planned - Road Admin</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td>Road Administration</td>
<td>✓</td>
<td>Cities - Mizar</td>
<td>✓</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>Planned - Road Admin</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Netherlands</td>
<td>Road Administration</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Norway</td>
<td>Road Administration</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portugal</td>
<td>Planned - Road Admin</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## RDS-TMC Services in Europe

<table>
<thead>
<tr>
<th>Country</th>
<th>Public Provider</th>
<th>Free</th>
<th>Commercial Provider</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spain</td>
<td>Road Administration</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweden</td>
<td>Road Administration</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switzerland</td>
<td>Road Administration</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The UK</td>
<td></td>
<td></td>
<td>iTMC (ITIS)</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Trafficmaster</td>
<td>✓</td>
</tr>
<tr>
<td>England</td>
<td></td>
<td></td>
<td>iTMC (ITIS)</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Trafficmaster</td>
<td>✓</td>
</tr>
<tr>
<td>Wales</td>
<td></td>
<td></td>
<td>iTMC (ITIS)</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Trafficmaster</td>
<td>✓</td>
</tr>
<tr>
<td>Scotland</td>
<td></td>
<td></td>
<td>iTMC (ITIS)</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Trafficmaster</td>
<td>✓</td>
</tr>
<tr>
<td>Northern Ireland</td>
<td></td>
<td></td>
<td>iTMC (ITIS)</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Trafficmaster</td>
<td>✓</td>
</tr>
</tbody>
</table>
Other Services in Europe

<table>
<thead>
<tr>
<th>Country</th>
<th>Public Provider</th>
<th>Free</th>
<th>Commercial Provider</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td></td>
<td></td>
<td>ÖAMTC – ERIC2000/3000</td>
<td>Members of ÖAMTC</td>
</tr>
<tr>
<td>Belgium</td>
<td></td>
<td></td>
<td>TCB – ERIC2000/3000</td>
<td>Members of TCB</td>
</tr>
<tr>
<td>Flanders (North)</td>
<td></td>
<td></td>
<td>TCB – ERIC2000/3000</td>
<td>Members of TCB</td>
</tr>
<tr>
<td>Walloon (South)</td>
<td></td>
<td></td>
<td>TCB – ERIC2000/3000</td>
<td>Members of TCB</td>
</tr>
<tr>
<td>France</td>
<td>Foreign members of ARC clubs</td>
<td></td>
<td></td>
<td>Members of ACR Clubs</td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td></td>
<td>ADAC – ERIC2000/3000</td>
<td>Members of ADAC</td>
</tr>
<tr>
<td>Italy</td>
<td></td>
<td></td>
<td>ACI – ERIC 2000/3000</td>
<td>Members of ACI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TarganInfomobility and Trafficmaster Joint Venture</td>
<td>Fiat car brands with bConnect Service</td>
</tr>
<tr>
<td>The UK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>England and partial Wales, Scotland and N. Ireland</td>
<td>Trafficmaster and RAC</td>
<td></td>
<td></td>
<td>RAC Members or buyers of Trafficmaster equipment or owners of cars equipped with trafficmaster equipment</td>
</tr>
</tbody>
</table>
Traffic Information Provision Outside Europe

- North America
- China
- Korea
- Australia

The Data Delivery Model in the U.S.

16 May 2006

2000 data messages
TMC/ALERT-C
Coded
15 Kbytes

Standard RDS-TMC FM Broadcast
TMC/ALERT-C Coded
5 bytes/message – 60 messages per minute on
a 1200 bits per second network.
Dynasty: RDS-TMC in China

- Demonstration of the first TMC service for China
- EU project coordinated by ERTICO
- Real-time test of the whole TMC chain with approximately 250 locations in Beijing.
- Taxis served as probe sensors for data collection and message generation was based on floating car data
- TMC messages were broadcast from the CCTV Tower building
- TMC messages were used for in-vehicle navigation.
VICS in Japan

- VICS, for Vehicle Information and Communication System, employs information collection techniques that are similar to those used in RDS-TMC.
- All of the navigation systems in the country use the coding scheme created by JDRMA.
- The Japan Road Traffic Information Center applies the traffic information to this database and delivers the information to vehicles equipped with VICS-enabled systems via radio beacons, infrared beacons and FM multiplex broadcast techniques.

The traffic data is processed using a national map database originally created by the Japan Digital Road Map Association (JDRMA).
Traffic Information Delivery
How we view the process today

Getting the message right  Getting the message to the driver
Service provider  Terminal manufacturer  Driver

Process
Originate content  Manage content  Broadcast  Receive  Calculate and present  Interpret and decide

Technical challenges today
- Availability of source data
- Limitations of location table
- Limitations on bandwidth
- FM Reception on Personal Navigation Devices
- Inconsistent treatment of messages between platforms
- Event based Alert C messages

Way forward
- Wider use of flow data
- "On the fly" location referencing
- Digital bearers
- Service Receiver Harmonisation group
- Traffic Event Compact
### Principal Traffic Information Collection Methods

<table>
<thead>
<tr>
<th>Technique</th>
<th>Broadcast</th>
<th>Verbal</th>
<th>Navigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor</td>
<td>Process to event</td>
<td>Convert to speed</td>
<td>Convert to impedance</td>
</tr>
<tr>
<td>Optical</td>
<td>Process to event</td>
<td>Convert to speed</td>
<td>Convert to impedance</td>
</tr>
<tr>
<td>Loop</td>
<td>Process to event</td>
<td>Convert to speed</td>
<td>Convert to impedance</td>
</tr>
<tr>
<td>Probe</td>
<td>Process to road and then to event</td>
<td>Road to speed</td>
<td>Road to speed to impedance</td>
</tr>
<tr>
<td>Vehicle</td>
<td>Process to road and then to event</td>
<td>Road to speed</td>
<td>Road to speed to impedance</td>
</tr>
<tr>
<td>Cellular</td>
<td>Process to road and then to event</td>
<td>Road to speed</td>
<td>Road to speed to impedance</td>
</tr>
<tr>
<td>Observe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth</td>
<td>Manually convert to event</td>
<td>Not applicable</td>
<td>Convert from observation to impedance</td>
</tr>
<tr>
<td>Aerial</td>
<td>Manually convert to event</td>
<td>Probably not applicable</td>
<td>Convert from observation to impedance</td>
</tr>
</tbody>
</table>

#### Market Degree of Importance

<table>
<thead>
<tr>
<th>Market</th>
<th>Qualitative Data</th>
<th>Quantitative Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadcast</td>
<td>Very High</td>
<td>Low</td>
</tr>
<tr>
<td>511-IVR</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Dynamic Navigation</td>
<td>Low</td>
<td>Very High</td>
</tr>
</tbody>
</table>
Flow-based Methods
Loop Detectors
Flow-based Methods
Loop Detectors

Intersection

Speed – 30 mph

Intersection

Speed – 40 mph

Intersection

Speed – 60 mph

Intersection

Speed – 65 mph
Flow-based Methods
Optical Sensors

Vehicle detected at Time T1

Same vehicle detected at Time T2

Link 102-103 Average Travel Time = Distance (103-102) / Time (T2-T1)
Flow-based Methods
Optical Sensors

Link 100-101

Optical Recognition Cameras

Link 102-103
Data Model
Optical Sensors

Measured speed from 103 to 104

103 Measured speed from 102 to 103

Traffic Link 102-103

Intersection Overpass Intersection Overpass

Optical Recognition Cameras

Database Link 1000

Prepared for the IQPC
Advanced Navigation Conference Berlin
November 2007
### Impedence Coding (example)

<table>
<thead>
<tr>
<th>Event Code</th>
<th>Message</th>
<th>Added Impedence FC 1-2</th>
<th>Added Impedence FC 3-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Traffic problem</td>
<td>1.25</td>
<td>2.0</td>
</tr>
<tr>
<td>101</td>
<td>Stationary Traffic</td>
<td>1.45</td>
<td>2.5</td>
</tr>
<tr>
<td>102</td>
<td>St. Traffic for 1 km</td>
<td>1.5</td>
<td>2.6</td>
</tr>
<tr>
<td><strong>103</strong></td>
<td><strong>St. Traffic for 2 km</strong></td>
<td><strong>2</strong></td>
<td><strong>3.0</strong></td>
</tr>
<tr>
<td>215</td>
<td>Accident(s) St. Traffic</td>
<td>1.45</td>
<td>2.5</td>
</tr>
<tr>
<td>571</td>
<td>Roadworks. Right lane closed</td>
<td>1.5</td>
<td>2.6</td>
</tr>
</tbody>
</table>
What needs fixing

The principal limitations today of most traffic information solutions in Europe (and most other places in the world) and what is being done about it:

- Lack of high quality traffic information: **Floating Vehicle Data**
- Difficulties of creating and maintaining location tables, and the inherent limitation of requiring that the tables are stored on reception devices: **TPEG and AGORA-C**
- Limited bandwidth available with RDS-TMC: **Digital Radio**
- Inconsistencies between platforms in the way messages are translated and used: **Standardisation of all messages types.**
- Limitation of pre-defined messages: **Use of Web services.**

*Illustration from presentation provided by BMW Group (10.11.2005) and delivered at the ITS World Congress 2005*
Pause
FCD, FVD or Probe

So-called “floating car data systems” offer a promising alternative to stationary traffic collection technologies, inductive loops, video-based and infrared-based systems. Floating car data systems have nothing to do with cars physically floating over the roadway. It is a rather ingenious term, invented by one of the transportation system intelligencia working on ways to reduce congestion without building new roads. The word float is Old English, flotian, meaning “body of water”.

There are many definitions of float, all more or less connected to doing something on or near water. The two definitions that best apply to the floating car application are:

•To move with a moving liquid: to drift; and,
•To pass from person to person, as in The rumor floated through the town.

The word float is related to the word fleet, which is “a group of vessels or vehicles moving or working together”.

FCD, FVD or Probe

The Floating Car Data (FCD) technique is based on a number of cars (in a fleet) being able to travel anywhere and deliver data from wherever they are. The cars are “floaters”, and are equipped with positioning technology and wireless data communications. Depending on the technique used, the on-board systems send their speed of travel and/or their positions to a central server. The server collects travel time information from vehicles and matches the locations to digital maps. The result is a map of average speeds along segments of the road network.

Another term that is used for the same technique is Probe Data. Probe in the verb form means “to search into or examine thoroughly. As a noun, a probe is “an investigation”, or it is “a vessel carrying scientific instruments to record or report back information about space or other planets—or even what is behind enemy lines”. Probe is derived from the Latin, proba, “a proof”, or probare, “prove”. [1]

I believe that Floating Vehicle Data (not just cars, but all types of vehicles) is a more appropriate term for describing the technique of data collection, and that Probe is a good name for one of the vehicles working in the fleet.
FCD, FVD or Probe

- Taxi-FCD developed by the German Aerospace Center (DLR)
- VMZ Berlin developed by DaimlerChrysler Services and Siemens
- OPTIS developed by Swedish group of companies led by the Swedish Road Administration.
- Mediamobile – France
- BMW Extended Floating Car Data – Germany
- T-Mobile (formerly Daten und Dienstleitungsgesellschaft DDG) – Germany
- Trafficmaster - UK
- ITIS – UK

The objective of VMZ Berlin is to record and evaluate the traffic situation in Berlin.
Floating Vehicle Data

- This is the Trafficmaster approach.
- Each time a point is measured, the vehicle’s speed is calculated.
- If the speed is lower than the speed listed in the on-board table, it is sent to the server for processing.
- If it is the same or higher, no data is sent.
Floating Vehicle Data

- This is the technique applied by DLR and ITIS.
- The in-vehicle system has no intelligence, and no data is stored on-board.
- The system sends data on a predetermined basis or when requested.
- The server calculates the speed along the most likely path of travel for the system.

Floating Car Data - No In-vehicle Data

The data sent includes the latitude and longitude of the positions collected by the system, a time stamp used to calculate speed, and possibly bearing angle.
Floating Cell Phone Data

Design objectives:

1. Privacy. Ensure that the personal details or whereabouts of a subscriber are never disclosed outside the operators’ network.
2. Security. Prevent any access to the mobile operators’ systems and customer information.
3. Impact. Passively monitor the mobile phone network and do not impact the load on network operations.
Floating Cell Phone Data

- This technique uses the mobile phone units inside vehicles as sensors to derive road traffic information.
- It relies on receiving signalling reports from the mobile network operators, which, thus far, has not been regulated by government bodies.
- The positional accuracy of this data is no higher than the distance between Base Station Transceiver Stations, which can be a few hundred metres in cities.

Typically, a mobile device generates a signalling report twice per second to enable the network operator to keep track of its own subscribers and the subscribers to other network who have roamed into their networks.
Mapping Mobile Phones

ITIS Holding’s Estimotion
TomTom’s Applied Generics

Applied Generics’ RoDIN24

Real Time Rome

BTS – Base Station Transceiver Station
BSC – Base Station Controller
MSC – Mobile Switching Center
SMS-C – Short Message Service Center
Research needed

- Does floating cellular data processing really work for real-time traffic data delivery?
- Will network operators continue to allow their data to be used by third parties, or will they attempt to monetize it themselves?
- Will the authorities allow personal data showing the movement of individuals’ handsets to be sold to companies like ITIS and TomTom, or used for estimating traffic patterns, real-time or historic?
TPEG: The future of traffic data delivery

- TPEG was first developed by the European Broadcasting Union starting in the mid-1990s.
- TPEG development was held back by the lack of a working location referencing method to relate traffic disturbances and incidents to a specific geographic location, and the lack of consumer take-up and government backing for digital radio.
Road Traffic Information Provision

- The FM radio data channel, at 1,200 bits/second and 35-bit data stream per event, was too limiting to use. Data messages are broadcast on a country or region basis, and the total number of messages that can be broadcast is 60 per minute.
- If the broadcast region is reduced in order to increase the total number of messages, the limitation on the total number of location codes per database reduces the addressable locations.
- The process becomes self-defeating.
Road Traffic Information Provision

- TPEG, which is based on messages that are at least twenty times larger than their ALERT-C equivalents, could not use the FM RDS-TMC channel.
- The move from FM analogue radio to digital radio is the principal reason that this shift to TPEG from RDS-TMC is being proposed at this time.
- Some governments are encouraging terrestrial digital audio broadcasting (T-DAB) while others are either waiting for a more evolutionary solution, like the HD-Radio being adopted in the US, and still others are counting on satellite digital radio to deliver a pan-European solution.

### TPEG International Profile

<table>
<thead>
<tr>
<th>TPEG-Message</th>
<th>MMC</th>
<th>APC</th>
<th>LRC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Message Management Container</td>
<td>Application Container</td>
<td>Location Referencing Container</td>
<td></td>
</tr>
</tbody>
</table>
## TPEG Applications and Standardisation Status

<table>
<thead>
<tr>
<th>Binary Name</th>
<th>XML Name</th>
<th>Applications</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPEG Binary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPEG XML</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B/TPEG</td>
<td></td>
<td>“B” relates to internal European Broadcasting Union work, and refers to Broadcasting technology.</td>
<td>TPEG Project- 3 years of validation. Work handed over to TPEG Forum.</td>
</tr>
<tr>
<td>TPEG-SSF</td>
<td></td>
<td>Syntax, Semantics and Framing Structure. Establishes frame structure related to ISO/OSI Layer Model.</td>
<td>Part 2 of binary standard</td>
</tr>
<tr>
<td>TPEG-SNI</td>
<td>tpeg-sniML</td>
<td>Service &amp; Network Information Provides broadcast channel and service information.</td>
<td>Part 3 of binary standard Part 8 of XML standard To be upgraded 2008</td>
</tr>
<tr>
<td>TPEG-RTM</td>
<td>tpeg-rtmML</td>
<td>Road Traffic Message. Event oriented, like RDS-TMC, and mapped to RDS-TMC. It is hierarchically structured to allow a wide range of service implementations.</td>
<td>Part 4 of binary standard Part 3 of XML standard To be upgraded 2008</td>
</tr>
<tr>
<td>TPEG-PTI</td>
<td>tpeg-ptiML</td>
<td>Public Transport Information Timetable changes oriented, but does not deliver timetables. Covers bus, train, ferry, air, other public transport. Being used now.</td>
<td>Part 5 of binary standard Part 4 of XML standard</td>
</tr>
<tr>
<td>TPEG-LOC</td>
<td>tpeg-locML</td>
<td>Location Referencing Based on the ILOC approach developed with in the EVIDENCE Project, which is not suitable for navigation applications. Being upgraded now. Upgraded name to be TPEG-LRC (see below)</td>
<td>Part 6 of binary standard Part 2 of XML standard Being upgraded now</td>
</tr>
</tbody>
</table>
# TPEG Applications and Standardisation Status

<table>
<thead>
<tr>
<th>Binary Name</th>
<th>XML Name</th>
<th>Applications</th>
<th>Status</th>
</tr>
</thead>
</table>
| TPEG-PKI    | tpeg-pkiML | Parking Information  
Provides information on parking areas, parking availability (dynamic)  
Dynamic information  
Based on work being performed in the German national project: mobile.info | Proposed part 7 and part 5 respectively  
Not standardised  
Being developed now, ballot early 2007 |
| TPEG-CTT    | tpeg-cttML | Congestion and Travel Time  
Designed to provide speed information on road segments.  
Korean local standard fixed, May 2006 | Proposed part 8 and part 6 respectively  
Not standardised  
Being developed now, ballot early 2007 |
| TPEG-TEC    | tpeg-tecML | Traffic Event Compact  
Designed to provide efficient transmission of road events.  
Provides cause and effect information.  
Oriented toward in-vehicle terminal devices.  
Based on work being performed in the German national project: mobile.info | Proposed part 9 and part 10 respectively  
Not standardised  
Being developed now, ballot late 2006 |
| TPEG-WEA    | tpeg-weaML | Weather for Travellers  
Provides a comprehensive weather services, with predictive information available 24 hours ahead.  
Oriented toward in-vehicle terminal devices.  
Based on work being performed in the German national project: mobile.info | Proposed part 10 and part 7 respectively  
Not standardised  
Being developed now, ballot late 2006 |
### TPEG Applications and Standardisation Status

<table>
<thead>
<tr>
<th>Application</th>
<th>Proposed Parts</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPEG-CAI</td>
<td>tpeg-caiML</td>
<td>Conditional Access Information&lt;br&gt;Transmit meta data to provide conditional access information.</td>
</tr>
<tr>
<td>TPEG-IDI</td>
<td>tpeg-idiml</td>
<td>Infrastructure Disturbance Information&lt;br&gt;Proposed to provide information about disturbances in the power, water and communications grids, how long the disturbances will last, and alternative sources</td>
</tr>
<tr>
<td>TPEG-MBT</td>
<td>tpeg-mbtML</td>
<td>Multimedia Based TTI&lt;br&gt;Proposed to provide images and video clips, particularly for T-DMB delivery channels.&lt;br&gt;Korean development in progress</td>
</tr>
<tr>
<td>TPEG-BSI</td>
<td>tpeg-bsiML</td>
<td>Bus Service Information&lt;br&gt;Provide bus route information, expected travel times&lt;br&gt;Korean development in progress</td>
</tr>
<tr>
<td>TPEG-SDI</td>
<td>tpeg-sdiML</td>
<td>Safety Driving Information&lt;br&gt;Provide information about locations that present dangerous situations for drivers&lt;br&gt;Korean development in progress</td>
</tr>
<tr>
<td>TPEG-POI</td>
<td>tpeg-poiML</td>
<td>Points of Interest&lt;br&gt;Provide information about POIs&lt;br&gt;Korean development in progress</td>
</tr>
<tr>
<td>TPEG-NWS</td>
<td>tpeg-nwsML</td>
<td>News Service&lt;br&gt;Provide news stories categorized for easy search.&lt;br&gt;Korean development in progress</td>
</tr>
<tr>
<td>TPEG-SPI</td>
<td>tpeg-spiML</td>
<td>Speed Information&lt;br&gt;Dynamic and temporary speed information, not static speed limits that are available in the database.</td>
</tr>
</tbody>
</table>
AGORA and AGORA-C

Location Referencing for Traffic Messaging, Map Updating

- On-the-fly location coding
- Further development of EVIDENCE
- References multiple types of locations
- Provides for Intersection Points, Routing Points and Location Points
- AGORA-C location references less than 50 bytes—AGORA resulted in larger sizes

Typical urban Location coded with AGORA

Location Reference example:
- Road work in Hanover
  - 3 Points
  - 12 Attributes
  - 55 Bytes message size
AGORA-C

The coding of a location according to the rules of AGORA-C consists of attaching the following attributes:

- Location Type (e.g. Intersection, POI, Road)
- Number of intermediate intersections
- Directional Reference (Positive, Negative, Both)
- Functional Road Class (FC0=main, etc.)
- Form of Way (e.g. Motorway, Roadabout, etc.)
- Road Descriptor (Street Name, Road Number)
- Heading (in degrees)
- Parallel Carriageway Indicator
- Intersection Type (e.g. Freeway, Roundabout, etc.)
- Routing Point Distance (distance to next routing point)
- Routing Point Direction Flag
- Road Descriptor of Side Road
- Side Road Heading
- Side Road Direction Flag
- Road Descriptor of Roundabout (Name, Road Number)
- Driving Direction (aligned with heading; reverse of heading)
Traffic Information Provision: Mobile.Info

TPEG with Mobile.Info

Science and Traffic
Project Mobile.Info / 3D (DAB Data Distribution).

- Goals of the project
  - Platform for the efficient distribution of unidirectional telematics services (e.g. road traffic information)
  - First steps towards reaching a critical mass for telematics services

- Project partners
  - German companies with a strong interest in significant improvements of road traffic information services
    - Car manufacturer and their supplies
    - Service providers and network operators
Digital Radio

- What is DAB? **DAB** is **Digital Audio Broadcasting**. According to the **DAB Association**, it is a “method for the digital transmission of radio signals”. The analogue radio sound signals are converted to a series of ones and zeros prior to sending, and decoded to sound at the receiving end. The intention is that digital radio will eventually replace analogue radio in the same way that digital television is replacing analogue TV.
- DAB is a broadband channel, 1.54 MHz, with data rates up to 1.2 megabits per second (Mbps). Compared to GSM, which is 9.6 kilobits per second (kbps), and GSM/GPRS, which is effectively 50 kbps, data transfer rates with DAB are significantly faster, and more data can be transmitted in the data packages.
Digital Radio

- DAB was first developed within a European research project called EUREKA in the late 1980s, and it is currently being implemented in countries around the world, including all European countries, Australia, Singapore, Taiwan, South Korea, China and India, and in the Americas in Canada, Mexico and Paraguay. It is not being implemented in the United States nor in Japan.
- In the U.S., the Federal Communications Commission has recommended adoption of its own standard called HD Radio (originally called IBOC for In Band On Channel). HD radio uses existing FM radio transmitters, and allows both analogue and digital signals to be transmitted simultaneously.
- While Terrestrial-DAB is viewed as an option in some European countries, the U.S. Federal Communications Commission has ruled that it is not to be made available in the U.S. because it does not provide an evolutionary path from the current AM/FM analogue broadcasting. The alternative to T-DAB is HD Radio, which offers 96 kilobits per second data transfer rates.
Digital Radio

- It is important to distinguish between two forms of DAB, Terrestrial-DAB and Satellite-DAB. T-DAB is the technology that is currently being implemented in the countries listed above. S-DAB, also called Satellite Digital Radio (SDR), is the technology behind Sirius and XM Radio in the United States.
- The main difference is that T-DAB, as the name implies, relies on ground transmission towers, while SDR uses satellites for transmissions with supplementary ground towers in areas where line-of-site is difficult, such as deep canyons, both natural and man-made.
Digital Radio

- Digital Radio Mondiale (DRM) – A digital replacement for AM radio. It is not a competitor to DAB as a digital replacement for analogue FM.
- Digital Video Broadcasting (DVB). DVB-T (Terrestrial) is intended for home and in-vehicles receivers, and DVB-H (Handheld) is intended for battery-powered portable devices, such as phones and PDAs.
- DVB-T is already a threat to DAB because it provides similar services as DAB, and often uses the same frequencies assigned to DAB.
- DVB-H could provide an opportunity for phone-based data delivery in the vehicle.

T-DAB
- Opel – The first T-DAB radios were introduced in the Astra in 2004.
- Ford – Dealers sell DAB radios in the U.K.
- BMW/Mercedes/Audi – These companies have been involved in a project called Mobile.Info in Germany where DAB services are being investigated and tested.

SDR
- In North America, both Navteq and its competitor Tele Atlas are delivering traffic information to vehicles via satellite radio. Initially
- Twenty-two metropolitan areas are being covered, but both companies are assembling data for additional areas. Navteq plans to have over fifty cities in its service by 2007.
# Digital Radio

## Advantages of DAB over Analogue and T-DAB over Satellite Radio

<table>
<thead>
<tr>
<th>Analogue Radio</th>
<th>Satellite Radio</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Sound quality can be significantly better than FM</td>
<td></td>
</tr>
<tr>
<td>• No interference between stations that are close in frequency, and no fading signals</td>
<td></td>
</tr>
<tr>
<td>• Access to more radio stations</td>
<td></td>
</tr>
<tr>
<td>• Data, audio, text and video services can be offered with T-DAB because of wide bandwidth</td>
<td></td>
</tr>
<tr>
<td>• More features available with T-DAB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• T-DAB is free while S-DAB will be subscription-based</td>
</tr>
<tr>
<td></td>
<td>• Programming is country-specific with T-DAB and in local language, while S-DAB will have to use channel capacity to broadcast in country-specific languages</td>
</tr>
<tr>
<td></td>
<td>• The shift from FM to T-DAB for the broadcasters is relatively easy, although costly, while S-DAB is very costly</td>
</tr>
</tbody>
</table>

## Disadvantages of DAB versus Analogue and T-DAB versus Satellite Radio

<table>
<thead>
<tr>
<th>Analogue Radio</th>
<th>Satellite Radio</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Consumers must purchase new radios</td>
<td></td>
</tr>
<tr>
<td>• The technology is more costly for all parties</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Access is continent-wide for voice, video and data transmission, so pan-European services can be provided.</td>
</tr>
<tr>
<td></td>
<td>• High quality sound is guaranteed</td>
</tr>
<tr>
<td></td>
<td>• Multiple languages can be broadcast simultaneously</td>
</tr>
<tr>
<td></td>
<td>• It is compatible with both T-DAB and Analogue radio, while T-DAB is not compatible with S-DAB.</td>
</tr>
</tbody>
</table>
Satellite Digital Radio System Overview

ONDAS Satellite Operations Centre

Content Uplink Station

ONDAS Broadcast Operations Centre

ONDAS on the Web

ONDAS Fixed Receiver

Terrestrial Repeaters

ONDAS Mobile Receiver

Future Evolution

Terrestrial Mobile Phone Networks

Internet

Return Channel

Content Providers

Terrestrial Mobile Phone Networks

ONDAS Fixed Receiver

Content Uplink Station

Content Providers

ONDAS Broadcast Operations Centre

2009-08-15

Prepared for the IQPC
Advanced Navigation Conference Berlin
November 2007
European L-Band SDARS Spectrum

- Flexible satellite payload will be capable of operation in a minimum of any seven and up to ten MUXes in the upper fourteen blocks
- Each block/MUX can support an average of 30 channels (i.e. over 200 channels)
Satellite Technologies

Optimal GEO System

ONDAS HEO System
Benefits of HEO v. GEO

ONDAS Extended Coverage

Prepared for the IQPC
Advanced Navigation Conference Berlin
November 2007
The SDRS Data Delivery Model in the U.S.


16 May 2006

- Traffic Data Suppliers
  - Data Feed
  - Pays for Data

- Navteq Traffic Aggregation
  - Data Feeds for Satellite Broadcast
  - Data Feeds in XML or Binary Formats
  - 2000 data messages TMC/ALERT-C Coded 15 Kbytes
  - Technology Assistance
  - Includes help with decoding message and integrating RDS-TMC Location Code Tables

- Satellite Digital Radio Company
  - Pays for Data
  - Pays Subscription Including Traffic
  - Has a Subscription Contract
  - Data Broadcast
  - Subsidizes Radio
  - Pays for Radio and First Year’s Traffic

- Satellite Radio Data Receiver (Delphi)
  - Navigation System
  - Vehicle OEM

- Customer
  - Vehicle with Navigation and Satellite Radio
  - Pays to
  - Delivers Data to
  - Delivers System to
  - Delivers Technology Assistance to
  - Has Subscription with

Standard RDS-TMC FM Broadcast
TMC/ALERT-C Coded
5 bytes/message – 60 messages per minute on a 1200 bits per second network.
Broadcast versus Telecommunications for Data

- Deliver continuous stream of traffic and other dynamic data
- Download the latest maps for the area where a customer is driving.
- Download guidebook information for a region or town.
- Download software that the customer needs for the specific country or terrain.
Modelling Traffic

- Traffic planners have been modelling traffic patterns for well over half a century.
- Their objective is to decide where to expand capacity and remove obstructions.
- Individuals perform a type of traffic modelling in their heads whenever they get into their car to make a journey.
- Helping navigation systems to think about what they should suggest today based on what happened yesterday, or last month or last year is what modelling is all about.

Source: ITIS Technologies Ltd.
Predictive Modelling of Traffic

- Real-time data alone does not provide good enough routing.
- Real-time traffic data is difficult and costly to acquire, and unless it is transferred from a flow-based system, it may not reach travellers until it is too late for them to take appropriate action.
- Daily commuters know when certain stretches of roads will be jammed with traffic, and they select alternate routes to avoid these road segments at those times when they are normally congested, but drive these same segments at other times of the day or week when traffic flows freely on them.
Modelling Traffic

- There is a great deal of activity at this time, both in Europe and in North America, to collect speed of flow data and to record it as an attribute in the data base so that it can be used for predictive route planning.
- Navteq in the US has its Navteq Traffic Patterns, TomTom, through its acquisition of Applied Generics, has a cellular-based data collection system, ITIS Holdings has both cellular- and floating vehicle-based data collection. Inrix claims to have special algorithms that do the job better than any of its competitors.
Eyes in the Sky

- The first traffic data collectors were reports flying around in helicopters, like the Sikorsky above.
- Maybe it’s time to consider what we are trying to convey to the users of traffic information.
- We are spending a great deal of time and money to collect traffic event and flow data and to present it to individual drivers, when perhaps the most effective way to accomplish this is to let the drivers see the situation for themselves.
- New technologies may make this possible. See The Economist November 3rd 2007: The fly’s a spy
Unmanned Aerial Vehicles

- The Exdrone system is a low-cost reconnaissance unmanned aerial vehicle designed for militar purposes.
- It is a delta platform flying wing air vehicle that is 5 feet long and has a wingspan of 8 feet, powered by a small one-cylinder, two-cycle, air-cooled engine with a two-blade propeller.
- The flight control system consists of a UHF uplink receiver connected to a Global Positioning System (GPS) based autopilot. It has three modes of operation: Manual flight, manual override autopilot, or full autonomous.

The Exdrone began as a research and development effort to build a low-cost expendable drone capable of carrying a VHF communications jammer. The aircraft have since been modified with several different payloads to provide reconnaissance.
Unmanned Aerial Vehicles

- The Exdrone has a launch weight of 89 pounds and a 25 pound payload capacity. The vehicle service ceiling is 10,000 feet, however, the mission altitude is usually between 3,000 - 4,000 feet above ground level.
- One of the payloads is the Pulinex TM-7i down-looking color TV camera, a commercial-off-the-shelf color camera providing 570 lines of resolution and a six power zoom lens.
- Other payloads available include an Image Intensifier, and Forward Looking Infrared (FLIR) cameras.

RQ-3A DarkStar Tier III Minus

The Tier III Minus UAV, known by the nickname DarkStar, is a system is a high-altitude, endurance unmanned air vehicle optimized for reconnaissance.
Unmanned Aerial Vehicle

- Onera, the French national aerospace centre, is developing a miniature robotic aircraft, code named REMANTA, that will be small enough to fly into a room through an open window and film the goings on of the room’s occupants.

- It is not a large stretch of the imagination to a small personal UAV that could climb up from the roof of a car to a few thousand feet to beam back images of the road ahead.
Unmanned Aerial Vehicle

Onera, A police helicopter weighing less than a kilo will be trialled in Liverpool as part of an attempt to cut antisocial behaviour.

The Microdrone MD4-200 is under a metre long and can be equipped with a 10-megapixel camera, digital video or low-light and infrared units.

The device can also be fitted with a GPS unit and sent on pre-programmed flights without a human operator.

"We are always looking at ways of putting more officers on the streets, and maximising technology is a powerful way of achieving this," said Simon Byrne, Assistant Chief Constable of Merseyside Police.

"The drone will support our Axis antisocial behaviour taskforce in gathering important evidence to put offenders before the courts.

"Other uses may include monitoring public disorder, crowd control during large scale events, and use during traffic congestion."
Vehicle-to-Vehicle Communications

- Vehicles that have experienced an incident, or sense that there are problems with the road surface, can signal cars in the vicinity, behind and ahead of the dangerous condition.
- Vehicle-to-vehicle communications short-cut the data collection and verification process and provides up-to-the-minute information.
Harmonised progression of interventions and integration of preventive, active and passive safety
A Future Navigation System

- Navigation systems have reduced the stress of wayfinding that we drivers had when we were using paper maps folded over steering wheels and street signs that were often hidden or not there.
- But blinding following turn-by-turn instructions can also be stressful, especially if an instruction is confusing or just plain wrong.
- The most effective navigation instruction is still “Go to a place you can see.”, or “Go to a place that you know.”.
Is Congestion Charging an answer?

- Who gains from congestion charging zones?
- What is the ultimate purpose of charging drivers for entering and exiting from the congestion zones?
- What are the real short-term and long-term effects of charging drivers for moving in and around cities?
- What can we learn from historical precedents?
- What are the alternatives to charging drivers for doing what they have done for free.
Two ways to beat traffic congestion

A normal Saturday on the main street in Tokyo’s Ginza shopping district.

A normal anyday in the virtual world of 3D navigation visualisation.
You can beat the traffic congestion problem. Take back the week or two of time you lose each year being stuck in traffic, and spend that time on something much more useful and productive. This book is intended to get you off the traffic treadmill.

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Questions

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